Search for the Jacobi shape transition in rapidly rotating nuclei: 1. Experiment

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It is a general property of rotating classical fluids that beyond a certain critical spin, L_1, the equilibrium shape changes abruptly from a slightly flattened configuration to a triaxial shape rotating about its shortest axis. With increasing spin, this configuration elongates very rapidly and disintegrates at a characteristic spin, L_2.

The discovery of such a transition from oblate to triaxial shapes was made in 1834 by C.G.J.Jacobi, in the context of rotating, idealized, incompressible gravitating masses. In 1961, Beringer and Knox [1] suggested that a similar transition might be expected in the case of atomic nuclei, idealized as incompressible, charged liquid drops endowed with surface tension. Theoretical studies in 1974 [2] and 1986 confirmed this. Superdeformed nuclei owe their elongation to shell effects, and are observed at relatively low spin (spin zero in some fission-isomers). By contrast, the existence of Jacobi-like configurations is due to the centrifugal force, and such shapes will appear only at very high spin: they should occur over a range of nuclei rather than in the small pockets characteristic of effects driven by shell-structure.

Evidence for Jacobi effects must be sought in the quasi-continuous gamma-spectrum emitted from states of high spin. We performed a series of experiments examining gamma-spectra from the bombardment of ^{50}Ti,^{64}Ni,^{96}Zr and ^{124}Sn targets with ^{48}Ca beams with the 8PI Spectrometer at Berkeley, and with Gammasphere at Argonne National Laboratory.

The spectra were processed by unfolding the Compton background, correcting for the efficiency. By comparing the processed HPGe spectra for successively higher K-values, (K is the number of detectors hit) we can isolate the spectrum of new (incremental) transitions feeding in at the top of the gamma-cascade. Typical results are summarised in Fig. 1, and are discussed in the contribution following.

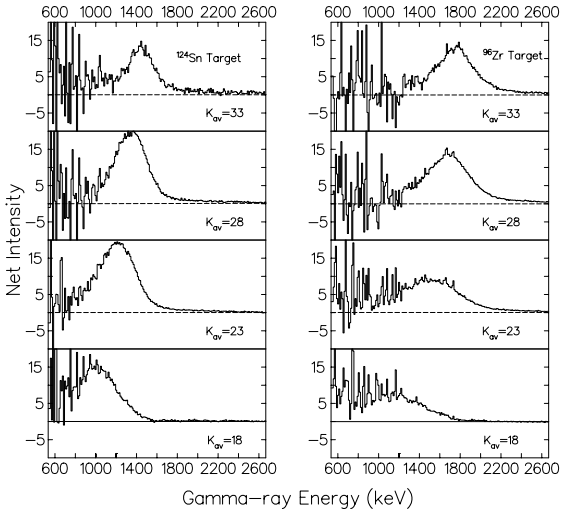

Figure 1: Incremental spectra derived by subtracting processed, normalised spectra gated on K+1 and K-1 fold-coincidences. The majority of the incremental strength lies in the E2 bump, for which a centroid-energy can be determined.

References

[1] R.Beringer and W.J.Knox ,Phys. Rev. 121 (1961) 1195

[2] S.Cohen,F.Plasil, and W.J.Swiatecki. Ann. of Phys. 82 (1974) 557